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AUTHOR Sorensen, H. Barbara
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ABSTRACT

The purpose of this research was to examine the relationship between semantic memory or integration and general ability. The main hypotheses are as follows: (1) the ability to memorize meaningless materials will not correlate with general ability; (2) the ability to abstract meaning from semantically related propositions will correlate with general ability; and (3) correlations between recongition confidence and general ability will increase systematically as the amount of semantic inferencing in the test sentences increases. Two separate experiments were conducted. A task was designed that used both a rote, or literal, performance memory task and a semantic, or relational, performance memory task. Test sentences were varied along three dimensions. Experiment 1 showed that older, more able students integrated semantically related sentences better than younger, less able students. Experiment 2 results were consistent with those of Experiment 1: significant, moderate correlations between semantic memory and general ability were found. However, this relationship was not as strong as found in Experiment 1. Both experiment results supported previous research indicating that there is little relationship between literal recognition and general ability. However, the experimental manipulation in Experiment 2 failed to work as expected. (PN)

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THE RELATION OF SEMANTIC INFERENCING TO GENERAL ABILITY ON A SENTENCE INTEGRATION TASK

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by

H. Barbara Sorensen

Psychological and Quantitative Foundations
College of Education
University of Iowa
Iowa City, Iowa 52242

TM 850 703

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The Relation of Semantic Inferencing to General Ability on a Sentence Integration Task

The purpose of this research was to examine the relationship between semantic memory or integration and general ability. The intention was first, to confirm previous research studies that found no relationship between learning and intelligence under meaningless or rote conditions (Gulliksen, 1942; Woodrow, 1946; Allison, 1960; Stake, 1964; Bunderson, 1967), and second, to simultaneously demonstrate that there is a relationship between intelligence and learning ability under meaningful or relational conditions (Kintsch,1974; Walker and Meyer, 1980; Wilhite, 1983).

The portion of this study investigating semantic memory is based on cognitive theory that suggests intelligence might be related to learning when learning is defined by how well a person integrates new information with prior knowledge.

Hypotheses

The main hypotheses for this study are as follows: (a) the ability to memorize meaningless materials will not correlate with general ability; (b) the ability to abstract meaning from semantically related propositions will correlate with general ability; and (c) correlations between recognition confidence and general ability will increase systematically as the amount of semantic inferencing in the test sentences increases.

Design

In order to investigate this relationship between general ability and semantic integration, two separate experiments were conducted. A task was designed that used both a rote, or literal, performance memory task and a semantic, or relational, performance memory task. In both of the experiments, test sentences were varied along three dimensions: (a) literal or semantic sentences; (b) correct or incorrect sentences; and (c) one, two, three, or four proposition ideas. A set of 56 recognition sentences was separated into two equivalent sets, one representing the first half of test sentences and one representing the second half of test sentences. Replication of a sentence type within a set was used as a control feature. Thus, two additional dimensions were considered: (a) first or second set of items, and (b) first or second replicate within sets. Except for eight four-proposition sentences, dimensions were fully crossed in a 2(4) x 3 within-subjects design (Figure 1).

Task

The experimental task was modeled after a previous study conducted by Bransford and Franks (1971) with several modifications and extensions. Bransford and Franks hypothesized that subjects would spontaneously integrate information from several consecutively but semantically related sentences into unified semantic ideas. This hypothesis was retained for both experiments with the exception that it was expected that high ability subjects would perform better than low ability subjects. The task for the two experiments consisted of 24 sentences that related to four overall ideas

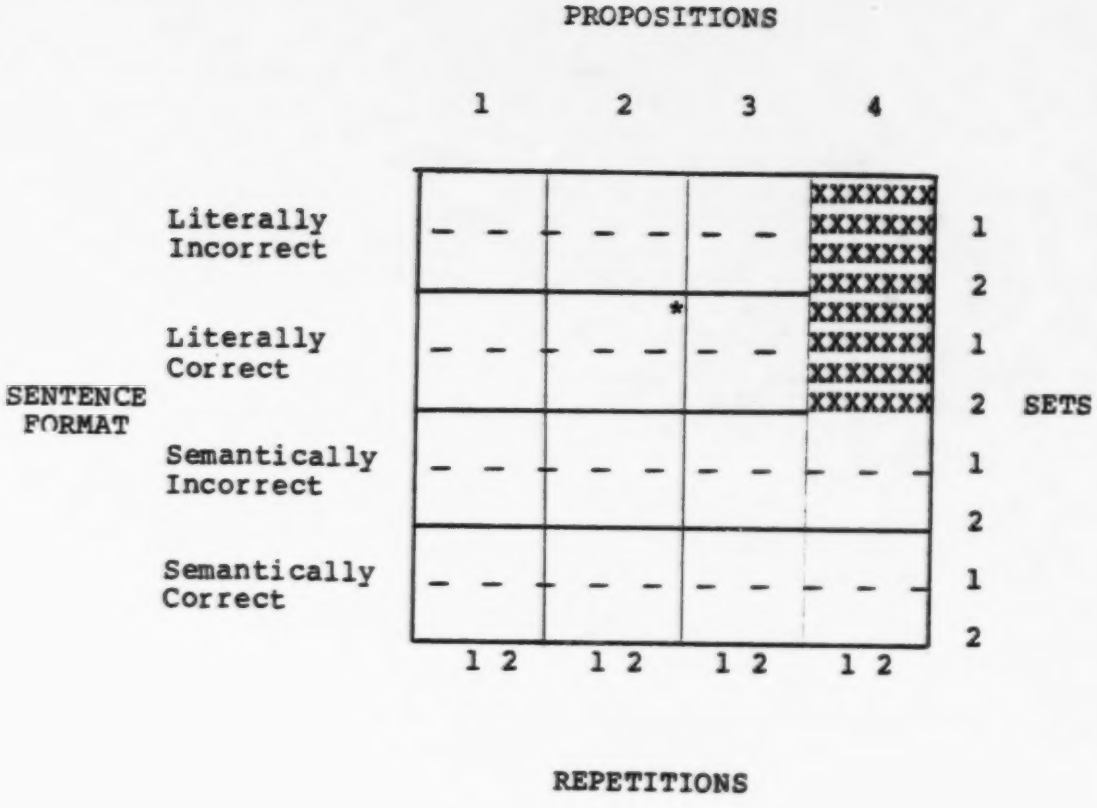

Figure 1. Design of Sentence Structure

(Table 1). In both experiments, sentences were presented orally to subjects; each sentence was then followed by a memory enhancement question. After answering the 24 questions,each subject was given a list of 56 sentences and instructed to indicate on a five-point recognition confidence scale whether the new sentence was exactly the same as the previous 24 target sentences (Table 2). Each of the 56 cells shown in Figure 1 was represented by one sentence, e.g., "The girl broke the window on the porch" represents a literally correct, two-proposition, first set, second replicate sentence. The * in Figure 1 represents the location of this sentence.

EXPERIMENT 1

Subjects

Ten adult and ten juvenile subjects participated in this study. The adults were all graduate students at the University of Iowa. Six were male and four were female. Of the ten juvenile subjects, six were female and four were male. The juvenile subjects were between 10 and 14 years of age. Subjects were recruited by word of mouth and by advertisements at the University of Iowa.

Ability Tests

Two ability tests were administered to each subject prior to the experimental task. The Raven Advanced Progressive Matrices (APM) (Raven, 1962) provided an estimate of fluid ability, and the Vocabulary Subtest of the Revised Wechsler Adult Intelligence Scale (Wechsler, 1981) was used to estimate verbal ability. A composite score formed by normalizing and then summing scores on these two tests provided an estimate of general ability while the difference between standard scores on the two tests provided an estimate of the verbal-fluid or verbal-spatial contrast. Each test was administered with standard instructions.

Results - Experiment 1

Subjects rated their recognition of each of 56 test sentences on a five-point scale. Responses to the 28 semantically or literally incorrect items were reflected before analysis so that higher scores would always indicate better performance.

The means, standard deviations,and correlations with reference variables are reported for each of the main effect cell totals in the design, separately for semantic and literal items (Table 3). Correlations were computed between each of these cell totals and Raven APM, WAIS vocabulary, and the sum and difference of standard scores on these two tests. The sum score approximates general intelligence, while the difference score (computed WAIS Vocabulary minus Raven APM) represents the unique variance in the verbal-fluid or verbal-spatial contrast.

Correlations of greatest interest are those between the sum score or general ability and recognition confidence. As predicted, the tendency to recognize semantically correct but new sentences was positively correlated with general ability (r=.53). Thus, more able students tended to think that they had previously heard sentences such as "The girl broke the large window on the porch" or "The old car pulling the trailer climbed the hill".

Table 1

Target Sentences

SENTENCES	QUESTION
The girl broke the window on the porch.	Broke what?
The tree in the front yard shaded the man who was smoking his pipe.	Where?
The old car climbed the hill.	What did?
The cat, running from the barking dog, jumped on the table.	From what?
The tree was tall.	Was what?
The cat running from the dog jumped on the table.	Where?
The hill was steep.	What was?
The girl who lives next door broke the window on the porch.	Lives where?
The car pulled the trailer.	Did what?
The scared cat was running from the barking dog.	What was?
The girl lives next door.	Who does?
The tree shaded the man who was smoking his pipe.	What did?
The scared cat jumped on the table.	What did?
The girl who lives next door broke the large window.	Broke what?
The man was smoking his pipe.	Who was?
The old car climbed the steep hill.	The what?
The large window was on the porch.	Where?
The tall tree was in the front yard.	What was?
The car pulling the trailer climbed the steep hill.	Did what?
The cat jumped on the table.	Where?
The tall tree in the front yard shaded the man.	Did what?
The car pulling the trailer climbed the hill.	Which car?
The dog was barking.	Was what?
The window was large.	What was?

Table 2

Test Sentences

The car pulling the trailer climbed the hill.	SA A UN D SD
The girl who lives next door broke the window on the porch.	SA A UN D SD
The barking dog jumped on the old car in the front yard.	SA A UN D SD
The old tree in the front yard shaded the old car.	SA A UN D SD
The girl who lives next door broke the large window on the porch.	SA A UN D SD
The girl on the front porch was shaded by the old tree.	SA A UN D SD
The old man who was smoking his pipe climbed the tree.	SA A UN D SD
The tall tree shaded the girl.	SA A UN D SD
The girl who lives next door broke the window.	SA S UN D SD
The scared cat, running from the dog, jumped on the table.	SA S UN D SD
The scared dog jumped on the table.	SA S UN D SD
The scared cat running from the barking dog jumped on the table.	SA S UN D SD
The car towing the trailer climbed the hill.	SA S UN D SD
The girl lives next door.	SA A UN D SD
The car climbed the steep hill.	SA A UN D SD
The girl broke the large window on the porch.	SA A UN D SD
The cat was frightened.	SA A UN D SD
The dog was scared.	SA A UN D SD
The old car pulling the trailer ascended the hill.	SA A UN D SD

Table 2 (continued)

The tree was in the front yard.	SA A UN D SD
The frightened cat was running from the barking dog.	SA A UN D SD
The girl broke the window on the porch.	SA A UN D SD
The car pulling the trailer climbed the steep hill.	SA A UN D SD
The man was smoking his pipe.	SA A UN D SD
The car climbed the hill.	SA A UN D SD
The dog jumped on the table.	SA A UN D SD
The oak was tall.	SA A UN D SD
The tall oak shaded the man.	SA A UN D SD
The girl shattered the window.	SA A UN D SD
The cat was running from the dog.	SA A UN D SD
The old man was smoking his pipe on the front porch.	SA A UN D SD
The man broke the window.	SA A UN D SD
The old car climbed the towering hill.	SA A UN D SD
The cat climbed the tree.	SA A UN D SD
The old car pulling the trailer climbed the hill.	SA A UN D SD
The scared cat jumped on the car in the front yard.	SA A UN D SD
The tall tree in the front yard sheltered the man.	SA A UN D SD
The scared cat was running from the barking dog.	SA A UN D SD
The cat running from the dog jumped on the table.	SA A UN D SD

Table 2 (continued)

The cat was scared.	SA A UN D SD
The large window was on the porch.	SA A UN D SD
The tall tree in the front yard shaded the man who was smoking his pipe.	SA A UN D SD
The tall tree shaded the man who was smoking his pipe.	SA A UN D SD
The frightened cat jumped on the table.	SA A UN D SD
The tree in the front yard shaded the man who was smoking hip pipe.	SA A UN D SD
The man broke the large window.	SA A UN D SD
The old man who lives next door broke the window on the porch.	SA A UN D SD
The hill was steep.	SA A UN D SD
The old car pulled the trailer.	SA A UN D SD
The tree sheltered the man smoking his pipe.	SA A UN D SD
The scared cat ran from the barking dog that jumped on the table.	SA A UN D SD
The scared dog was running from the cat.	SA A UN D SD
The dog was barking.	SA A UN D SD
The old car pulling the trailer climbed the steep hill.	SA A UN D SD
The cat was running from the barking dog.	SA A UN D SD

These sentences were never actually presented, although the idea units were contained in one or more of the target sentences. The tendency to reject semantically incorrect sentences was even more highly correlated with general ability (r=.73), suggesting that accurate recognition of semantic errors may be more characteristic of the high ability subjects than the tendency to integrate idea units. Thus, more able students tended to think that they had not previously heard sentences such as "The barking dog jumped on the car in the front yard" and "The man broke the window", sentences that represent incorrect inferences.

Overall, recognition confidence for semantic items was highly correlated with general ability (r=.71). Thus, more able students tended to be better at rejecting semantic errors and at recognizing semantically correct but new sentences than less able students.

As indicated in Table 3, correlations between recognition confidence and general ability increased systematically with the number of propositions in the test sentences. Recognition confidence of correct and incorrect semantic sentences containing one proposition, such as "The tree was in the front yard" and "The dog was scared", showed low, and for this sample size, nonsignificant correlations with general ability (r=.31). However, as the length of the sentence increased to two propositions, such as "The girl who lives next door broke the window" and "The scared dog jumped on the table", there was a significant relationship between general ability and recognition confidence(r=.49). And, for three proposition sentences, the relationship between general ability and recognition confidence was even stronger(r=.70). Thus, more able students tended to recognize correct and incorrect semantic items of three propositions, such as "The scared cat, running from the dog, jumped on the table" and "The old man was smoking his pipe on the front porch." Finally, recognition confidence for never presented four proposition semantic sentences, such as "The old car pulling the trailer climbed the steep hill" and "The scared cat running from the barking dog jumped on the table" was most strongly related to general ability (.78).

Analyses beyond those shown in Table 3 revealed a pattern of increasing correlations between recognition confidence and general ability as the number of propositions in the test sentences increased. These were strongest for rejecting semantically incorrect sentences (r=.16, .61, .55, and .83 for one through four propositions, respectively).

High ability students tended to perform better on semantic items for both Set 1 (r=.71) and Set 2 (r=.60). The slight drop in correlations across sets may be suggestive, but is certainly not significant.

Correlations between the recognition confidence scale score and general ability for literal items showed no significant relationship within any dimension of the design. However, the difference between the WAIS Vocabulary subtest score and the Raven APM score was significantly correlated with recognition confidence for the first Set of literal items (r=.57). Students with much higher vocabulary than Raven APM scores tended to perform better than other students on the first set of literal items. However, as expected, this effect disappeared in the second Set.

Table 3

Means, Standard Deviations, and Correlations between Recognition Confidence and Reference Variables, Separately for Semantic and Literal Main Effect Cell Totals (N=20)

	Raven	Vocab	Sum	Diff	M	SD	n(a)
SEMANTIC							
Total	.66*	.73*	.71*	.16	4.02	.474	32
Set 1	.60*	.62*	.71*	.05	4.10	.511	16
Set 2	.55*	.62*	.60*	.16	3.93	.513	16
Correct	.43	.59*	.53*	.36	3.77	.531	16
Incorrect	.71*	.71*	.73*	.00	4.26	.537	16
Prop 1	.33	.27	.31	-.13	3.82	.434	8
Prop 2	.43	.54*	.49*	.24	4.01	.619	8
Prop 3	.68*	.73*	.70*	.10	4.12	.639	8
Prop 4	.70*	.82*	.78*	.26	4.11	.590	8
LITERAL							
Total	-.20	.00	-.10	.45*	3.60	.397	24
Set 1	-.01	.25	.12	.57*	3.76	.412	12
Set 2	.25	.24	.25	-.02	3.40	.399	12
Correct	-.16	-.02	-.09	.32	3.61	.534	12
Incorrect	-.13	.02	-.05	.32	3.59	.582	12
Prop 1	-.24	-.05	-.14	.41	3.78	.489	8
Prop 2	-.18	-.05	-.21	.29	3.33	.379	8
Prop 3	-.07	.05	.04	.30	3.69	.618	8

(a) Number of items in each cell for each subject.
* $p < .05$.

Several different repeated measures analyses were also performed on the data. These analyses were complicated by two factors: (1) the design was not fully crossed because four proposition test sentences were presented only in the semantic condition; and (2) the distribution of general ability was quite skewed.

The solution to these complications was to analyze semantic and literal items separately, and to compute contrast scores for each main effect constrast in the design for each subject. These scores were then correlated with reference ability tests and factors. When squared, the correlations showed the percent of variance in each subject-dimension interaction that can be explained by different abilities. (Partial list at Table 4).

Repeated measures analyses of variance were performed separately for semantic and literal items and are reported in Tables 5 and 6, respectively. Subjects and replications were considered random effects; all other dimensions were considered fixed. There were four large effects in the analysis of variance for semantic items shown in Table 5. The subject dimension captured the most variance, indicating substantial individual differences in average reported confidence. The significant main effect for correctness indicates that subjects were generally more confident in their rejection of semantically incorrect sentences than in their acceptance of semantically correct sentences ($F(1,19) = 19.61, p = <.05$). However, the interaction between correctness of the test sentence and number of propositions in the test sentence shows that this effect varied with the number of propositions in the test sentence. As shown in Figure 2, the effect was largest for one proposition test sentences and then decreased systematically. The significant three-way interaction further qualifies the effect: Subjects were less confident in their rejection of three and four proposition test sentences in the second set.

The analysis of variance for literal items is reported in Table 6. Subjects expressed more confidence in their responses for the first set of items than for the second set of items ($F(1,19) = 20.08$, $p < .05$), possibly due to proactive interference from the first set of items. The larger CP interaction is plotted in Figure 3. One proposition, literally incorrect sentences were rejected with much greater confidence than all other types of sentences, possibly due to distinctiveness. The significant BP interaction reveals that this effect was most pronounced in the first set of items. Finally, the large NC interaction reveals considerable individual variability in the difference between confidence in rejecting literally incorrect sentences and accepting literally correct sentences. However, none of the variance in this effect was explained by the ability composites. This is shown in the correlations between main effect contrast scores and reference tests reported in Table 5.

Table 4 also reveals that the tendency to be more confident in semantic ratings was highly correlated with general ability ($r = .79$). This in part reflects the correlation between performance on the semantic items and general ability ($r = .71$), since the scores were more variable for semantic than for literal items ($SD = .47$ and $.39$, respectively).

TABLE 4

Correlations between Main Effect Contrast Scores and Reference Variables (N=20)

	Raven	Vocab	ZSUM	ZDIFF
SEMLIT	.80*	.70*	.79*	-.13
LITLIN	.14	.18	.16	.08
LITQUAD	.07	.18	.13	.23
LITSET	-.32	-.39	-.37	-.15
LITCOR	-.01	-.02	-.02	-.02
SEMSET	-.14	-.12	-.14	.04
SEMCOR	-.33	-.12	-.23	.46*
SEMLIN	.52*	.54*	.55*	.03
SEMQUAD	-.10	-.23	-.17	-.28

Note.

SEMLIT = Semantic - Literal

LITLIN = Literal (P3) - Literal (P1)

LITQUAD = Literal (P1)/2 + Literal (P3)/2 - Literal (P2)

LITSET = Literal set 2 - Literal set 1

LITCOR = Literal correct - Literal incorrect

SEMSET = Lemantic set 2 - Semantic set 1

SEMCOR = Semantic correct 1 - Semantic incorrect

SEMLIN = 3P4 + P3 - P2 - 3P1

SEMQUAD = P1 - P2 - P3 + P4

* $p < .05$.

Table 5

Analysis of Variance on Recognition Confidence for Semantic Items

Source	df	MS	(a)	F	Source	df	MS	(a)	F
Mean	1	-	-	-	Subj(N)	19	7.19	.18	5.58*
Set(B)	1	4.56	.01	3.73	NB	19	1.22	0(b)	.94
Corr(C	1	38.02	.11	19.61*	NC	19	1.94	.04	.08
Prop(P)	3	3.14	.01	2.74	NP	57	1.15	0(b)	.89
BC	1	1.22	0	1.30	NBC	19	.94	0(b)	.79
BP	3	1.04	0	1.08	NBP	57	.96	0	.92
CP	3	11.77	.13	8.51*	NCP	57	1.38	.02	1.07
BCP	3	4.25	.09	5.26*	NBCP	57	.81	0(b)	.63
					R(NBCP)	320	1.29	1.29	

(a) Estimated variance component.

(b) Negative variance component replaced by zero.

* $p < .05$.

Table 6

Analysis of Variance on Recognition Confidence for Literal Items

Source	df	MS	(a)	F	Source	df	MS	(a)	F
Mean	1	-	-	-	Subj(N)	19	3.79	.08	2.04*
Set(B)	1	12.03	.05	20.08*	NB	19	.60	0(b)	.32
Corr(C	1	.08	0(b)	.02	NC	19	3.72	.16	2.00*
Prop(P)	2	8.93	.05	7.65*	NP	38	1.17	0(b)	.63
BC	1	.41	0(b)	.29	NBC	19	1.42	0(b)	.76
BP	2	5.45	.05	4.54*	NBP	38	1.20	0(b)	.65
CP	2	31.54	.38	22.13*	NCP	38	1.42	0(b)	.77
BCP	2	2.69	.04	2.54	NBCP	38	1.06	0(b)	.57
					R(NBCP)	240	1.86	1.86	

(a) Estimated variance component.

(b) Negative variance component replaced by zero.

* $p < .05$.

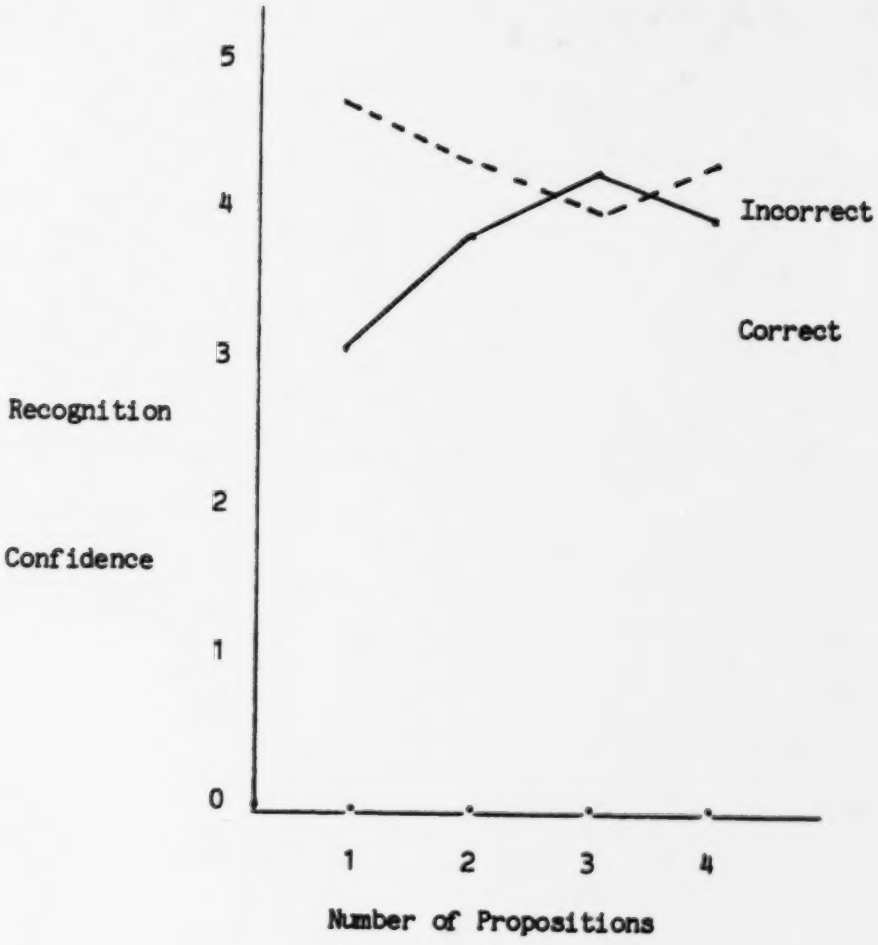

Figure 2. CP Interaction - Semantic Items. Correctness by Proposition.

Discussion

This study, in agreement with others reported in the literature (e.g., Bunderson, 1967), found that the ability to recognize a particular syntactic structure, a relatively meaningless activity, was independent of general ability.

More importantly, however, the tendency of more able subjects to recognize semantically correct sentences suggests that learning and intelligence are related, but only when the learning measure assesses inference and integration abilities, and when the task is sufficiently complex.

Others (Walker and Meyer, 1980; Wilhite, 1983) have reported that when reading a passage,more able students attend to higher-order idea units and less able students attend to more distinctive, but lower-order information. The effect found in this study is similar, but it involves a more active construction of the overall ideas. High ability subjects may be better at inferring, or building, correct semantic propositions, or may be simply more likely to engage in these types of activities automatically. This later interpretation seems more plausible because it seems unlikely that less able students are in some way unable to attend to ideas, rather than details, and integrate ideas over sentences. Further, the hypothesis that general ability is at least partly a reflection of meaning seeking habits of thought has broader appeal (Cronbach and Snow, 1977). However, the present data do not provide more support for one of these positions than the other.

The second experiment was designed to replicate these findings with a more representative sample of subjects and, at the same time, to manipulate experimentally the relationship between general ability and integration.

EXPERIMENT 2

In this experiment, subjects were randomly assigned to one of two groups. Subjects in the control group performed the same experimental task described in the first experiment, except it was in a group setting. Subjects in the treatment group performed the same task except that they were asked to classify each of the 24 experimental sentences into one of four idea groups immediately after they heard each sentence. If high ability subjects automatically engage in the elaboration process, then the experimental manipulation should benefit only low ability students, and thus reduce (or even eliminate) the correlation between general ability and recognition confidence.

Subjects

The subjects were 80 undergraduate volunteers (37 males and 43 females) from the College of Education (25 subjects) and the College of Business (55 subjects). Approximately 70% of the participants were freshmen or sophomores and 30% were juniors or seniors.

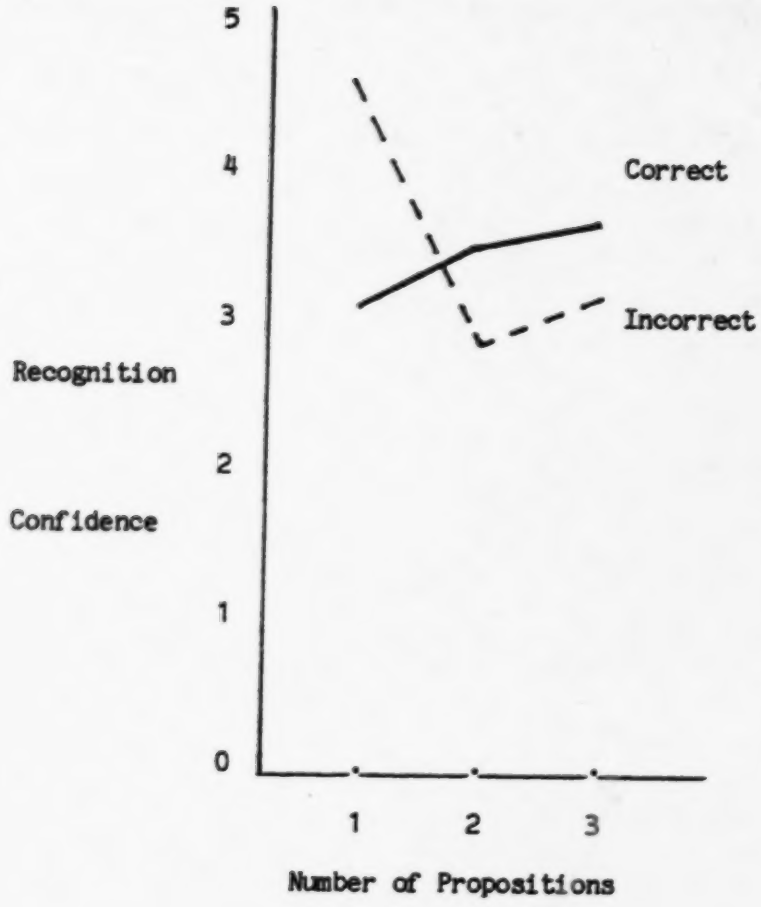

Figure 3. CP Interaction - Literal Items. Correctness by Proposition.

Procedure

Forty subjects were randomly assigned to each of two conditions in the experiment. The experimental task was again modeled after the Bransford and Franks study (1971) described in Experiment 1.

The 24 target sentences were presented orally to all subjects and each sentence was followed by a short question. All subjects were instructed to attempt to remember the sentence exactly as spoken. After listening to the sentences and the questions, subjects in the first condition were instructed to write their responses on a sheet of paper containing 24 blank spaces.

Subjects in the treatment condition were instructed to first categorize each proposition into one of four labeled boxes by recording the number of the sentence in the appropriate box. The four boxes were labeled as follows: (1) car & hill; (2) girl & window; (3) cat & dog; and (4) man & tree. They then recorded their responses to the questions on the response sheet just as the subjects in the control group had.

Thus, the control condition was an attempt to adapt the procedure used in Experiment 1 to a group administration, while the treatment condition was an attempt to induce a strategy of attending to overall ideas in all subjects.

After listening and responding to the 24 sentence-question pairs, all subjects were given a list of 56 sentences. They were instructed to read each sentence as it was read aloud and to decide whether the sentence was exactly the same as one presented orally in the first part of the experiment.

Results - Experiment 2

Several differences existed between the subjects and methods used in Experiment 1 and Experiment 2. First, subjects in Experiment 1 were tested on an individual basis, whereas subjects in Experiment 2 were tested in a group setting. Second, Experiment 1 used extreme ability groups of graduate students and children, while Experiment 2 used a more homogeneous group. Third, ability of subjects in Experiment 1 was assessed individually by the Raven APM and WAIS Vocabulary tests. Ability estimates for subjects in Experiment 2 were based on ACT composite scores.

Except for imposed manipulation in the treatment condition, criteria for subjects in both conditions of Experiment 2 were identical. Subjects in both conditions received identical test administrations, and all subjects had ACT scores in an equivalent range for college undergraduates.

Preliminary analyses indicated that there was no ceiling effect. However, subjects who did not follow directions or had obviously responded randomly were eliminated.

The basic results of Experiment 2 are shown in Table 7. Means and standard deviations of cell means and ACT scores are provided separately for the treatment and control groups. As shown in Table 7, average scores indicate that the control group performed significantly better than the treatment group on virtually all item types.

Table 7

Means and Standard Deviations for Cell Means and Correlations between Individual Cell Means and ACT Scores separately for Treatment (N=26) and Control (N=32) Groups

	Treatment		Control			Correlation w/ ACT	
						Treatment	Control
Variable	M	SD	M	SD	t (a)	r	r
Overall	3.86	.24	4.12	.28	3.55*	.22	.16
Set 1	3.97	.28	4.28	.32	3.77*	.01	.13
Set 2	3.75	.26	3.95	.32	2.48*	.38*	.15
Literal	3.60	.31	3.92	.34	3.67*	-.11	.07
Semantic	4.06	.33	4.26	.34	2.26*	.36*	.18
Incorrect	4.04	.43	4.40	.41	3.17*	.01	-.02
Correct	3.69	.48	3.84	.55	1.06	.20	.18
Prop 1	3.59	.48	3.89	.39	3.12*	.33*	.08
Prop 2	3.84	.32	4.04	.42	2.01*	-.12	.02
Prop 3	4.01	.36	4.22	.39	2.21*	.10	.19
Prop 4	4.18	.46	4.51	.39	2.93*	.35*	.23
Set 1 Lit	4.09	.40	4.11	.41	2.80*	-.26	.11
Set 1 Sem	3.38	.35	4.41	.34	3.21*	.20	.11
Set 2 Lit	3.38	.35	3.73	.40	3.45*	.08	.00
Set 2 Sem	4.03	.36	4.12	.41	.83	.43*	.22
Set 1 Incor	4.07	.51	4.45	.38	3.20*	-.35	.02
Set 1 Cor	3.88	.51	4.12	.61	1.58	.27	.12

Table 7 (continued)

Set 2 Incor	4.01	.50	4.35	.53	2.48*	.28	.05
Set 2 Cor	3.50	.60	3.56	.68	.34	.10	.19
Set 1 Prop 1	3.78	.38	4.16	.48	3.21	.00	.10
Set 1 Prop 2	3.97	.42	4.25	.54	2.16	-.25	.11
Set 1 Prop 3	4.10	.42	4.31	.43	1.86	&16	.12
Set 1 Prop 4	4.12	.67	4.53	.41	2.72(b)	.15	-.08
Set 2 Prop 1	3.39	.46	3.62	.51	1.74	.46*	.03
Set 2 Prop 2	3.71	.41	3.83	.47	1.04	.07	-.07
Set 2 Prop 3	3.91	.44	4.14	.49	1.77	.01	.18
Set 2 Prop 4	4.25	.55	4.50	.54	1.71	.40*	.40*
Lit Prop 1	3.52	.45	3.92	.41	3.48	.05	.05
Lit Prop 2	3.40	.40	3.75	.59	2.65(b)	-.03	-.12
Lit Prop 3	3.87	.52	4.09	.47	1.64	-.22	.25
Sem Prop 1	3.65	.47	3.86	.50	1.57	.41*	.08
Sem Prop 2	4.27	.45	4.33	.48	.45	-.14	.20
Sem Prop 3	4.14	.48	4.35	.46	1.37	.40*	.05
Sem Prop 4	4.18	.46	4.51	.39	2.93	.35*	.23

* $p < .05$.
(a)$p < .05$ two-tailed.
(b) computed for unequal variances.

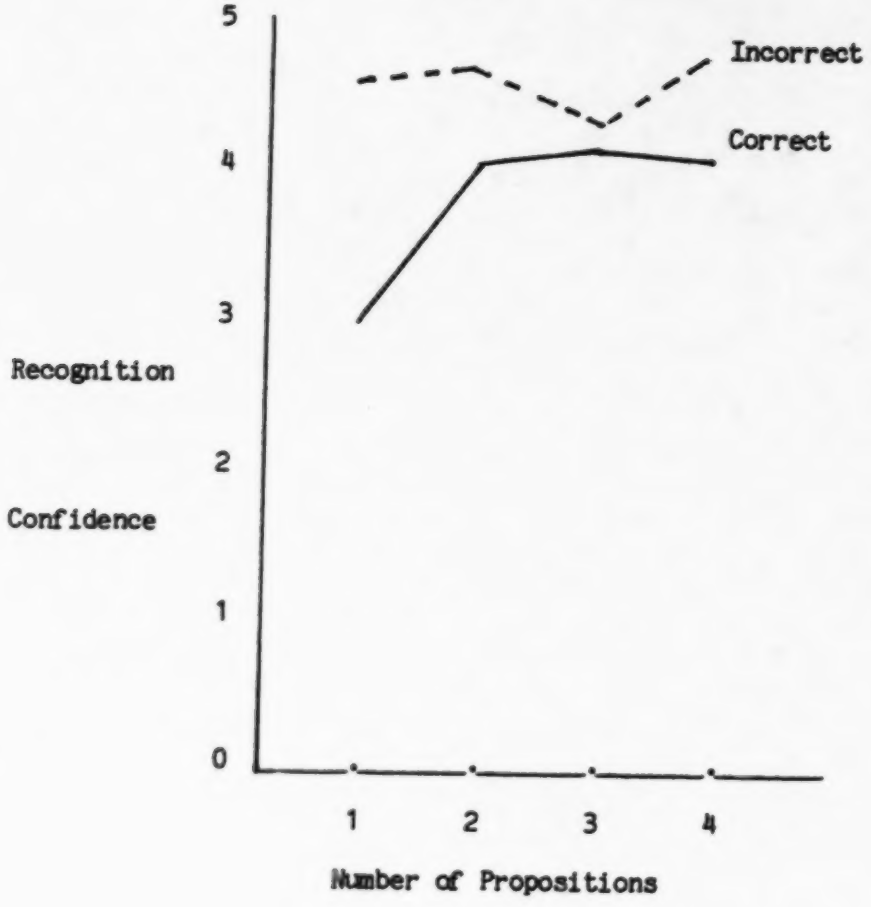

Figure 4. CP Interaction - Semantic Items. Correctness by Proposition.

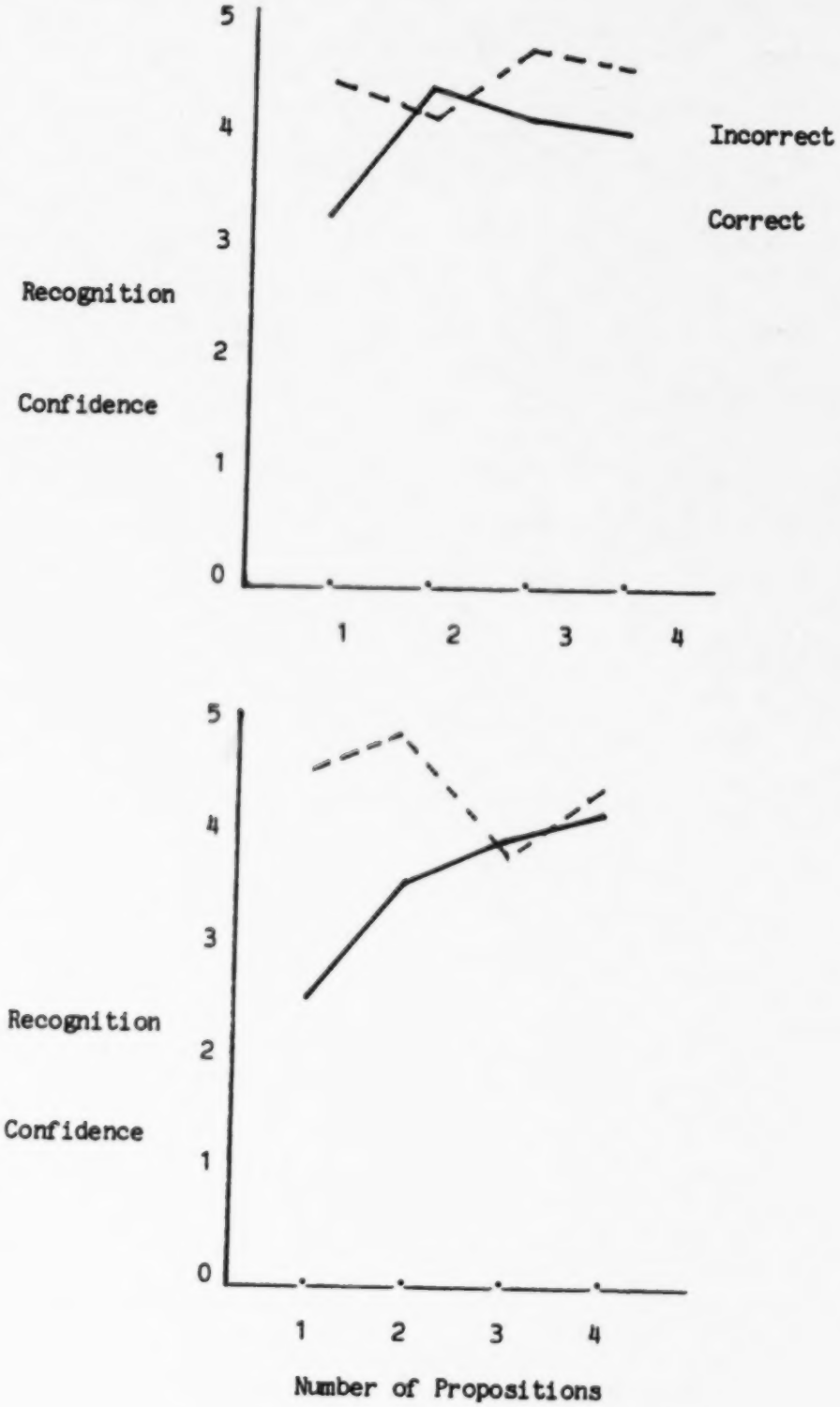

Figure 5. CPS Interaction - Semantic Items. Correctness by Proposition by Set.

Correlations were computed between each individual's cell means (sentence score)and their ACT score. Contrary to expectations, the tendency to recognize semantic items was correlated with ACT (r=.36) for subjects in the treatment group. Therefore, those subjects who had high ACT scores also tended to recognize semantically correct foils and reject semantically incorrect foils. However, this correlation was not significantly different from zero for the control group as it was in Experiment 1.

For both Proposition 1 (r=.33) and Proposition 4 (r=.35) on all item types and both sets, performance in the treatment group was significantly related to ACT scores. High ability subjects in the treatment group tended to recognize both semantically correct and incorrect but inferred relationships better than less able students (r=.41, .40, and .35, for one, three, and four propositions, respectively). The corresponding correlations for the control group were not significantly different from zero. The rersults for the control group were not significantly different from zero.

The only significant correlation between recognition confidence and ACT scores for the control group was for four proposition semantic items in Set 2 (r=.40). This finding is consistent with the results of Experiment 1.

Two separate analyses of variance were performed on the data. The analyses of semantic items and of literal items were performed separately in order to accommodate the unequal distribution of ability for the reduced groups, and to compensate for the design not being fully crossed with respect to semantic items for Proposition 4. Results are reported separately in Tables 8 and 9. Appropriate main effects and interactions are reported.

All facets of the design were considered fixed effects. There were 17 large effects in the analysis of variance for semantic items, shown in Table 8.

The significant main effect for correctness indicates that subjects were generally more confident in their rejection of semantically incorrect sentences than in their acceptance of semantically correct sentences ($F(1, 61) = 34.05$, $p<.0$). This same effect was also found in Experiment 1.

The interaction between correctness of the test sentence and number of propositions in the test sentence is shown in Figure 4. Semantically incorrect one proposition test sentences were rejected with considerably more confidence than semantically correct one proposition sentences were accepted. This effect was stronger than for the corresponding CP interaction for semantic items in Experiment 1. The significant three-way interaction shows that the effect was strongest in the second set of items. This interaction is shown in Figure 5.

The analysis of variance on recognition confidence for literal items is reported in Table 9. Subjects expressed more confidence in their responses for the first set of items than for the second set of items ($F(1,16) = 47.54$, $p<.0$). This effect may be due to proactive interference from the first set of items. The effect was also found in Experiment 1.

The CP interaction is plotted in Figure 6. Subjects rejected one proposition incorrect sentences more confidently than one proposition correct sentences. This effect could be due to the more obvious

Table 8

Analysis of Variance on Recognition Confidence for Semantic Items

Source	df	MS	F	Source	df	MS	F
BETWEEN							
Ability(A)	2	5.20	.65				
Condition(E)	1	46.4	5.81*				
AE	2	2.36	.30	Subjects (E)	74	7.98	6.35*
WITHIN							
Set (S)	1	24.13	13.22*				
SA	2	2.10	1.15				
SE	1	9.37	5.14*				
SAE	2	.39	.22	N(SE)S	74	1.82	1.45
Correct (C)	1	32.34	1.74				
CA	2	6.23	.34				
CE	1	4.78	.26				
CAE	2	6.91	.37	N(AE)C	74	18.60	14.80*
SC	1	6.06	2.56				
SCA	2	5.25	2.22				
SCE	1	.31	.13				
SCAE	2	2.00	.85	N(AE)SC	74	2.36	1.88
Prop (P)	3	32.76	28.70*				
PA	6	1.07	.95				
PE	3	1.41	1.24				

PAE	6	.94	.82	N(AE)P	222	1.14	.91
SP	3	4.00	3.70*				
SPA	6	.26	.25				
SPE	3	1.58	1.46				
SPAE	6	.93	.87	N(AE)SP	222	1.08	.86
CP	3	30.57	17.99*				
CPA	6	3.42	2.02				
CPE	3	2.20	1.30				
CPAE	6	.96	.56	N(AE)CP	222	1.69	1.35
SCP	3	28.62	25.32*				
SCPA	6	.69	.61				
SCPE	3	1.13	1.01				
SCPAE	6	2.09	1.85	N(AE)SCP	222	1.13	.90

[a] MS(e) estimated by N(AE)SCPR interaction of 1.257.

*$p < .05$.

Table 9

Analysis of Variance on Recognition Confidence for Literal Items

Source	df	MS	F	Source	df	MS	F
BETWEEN							
Ability(A)	2	3.21	1.22				
Condition(E)	1	35.54	13.46*				
AE	2	2.17	.82	Subjects (E)	52	2.64	2.07
WITHIN							
Set (S)	1	44.70	47.54*				
SA	2	2.03	2.16				
SE	1	.87	.93				
SAE	2	2.23	2.37	N(SE)S	52	.94	.74
Correct (C)	1	26.86	4.18				
CA	2	10.85	1.69				
CE	1	7.44	1.16				
CAE	2	.69	.11	N(AE)C	52	6.43	5.05
SC	1	20.33	11.64*				
SCA	2	1.72	.99				
SCE	1	.00	.00				
SCAE	2	.06	.04	N(AE)SC	52	1.74	1.34
Prop (p)	2	16.43	10.53*				
PA	4	.68	.44				
PE	2	.95	.61				

PAE	4	1.03	.66	N(AE)P	104	1.56	1.23
SP	2	21.26	12.55*				
SPA	4	1.35	.80				
SPE	2	.94	.56				
SPAE	4	1.92	1.14	N(AE)SP	104	1.69	1.33
CP	2	95.28	56.43*				
CPA	4	1.71	1.02				
CPE	2	.56	.35				
CPAE	4	.46	.27	N(AE)CP	104	1.68	1.32
SCP	2	1.48	.80				
SCPA	4	4.52	2.44				
SCPE	2	2.78	1.50				
SCPAE	4	1.55	.84	N(AE)SCP	104	1.85	1.45

[a] MS(e) estimated by N(AE)SCPR interaction of 1.27185.

*$p < .05$.

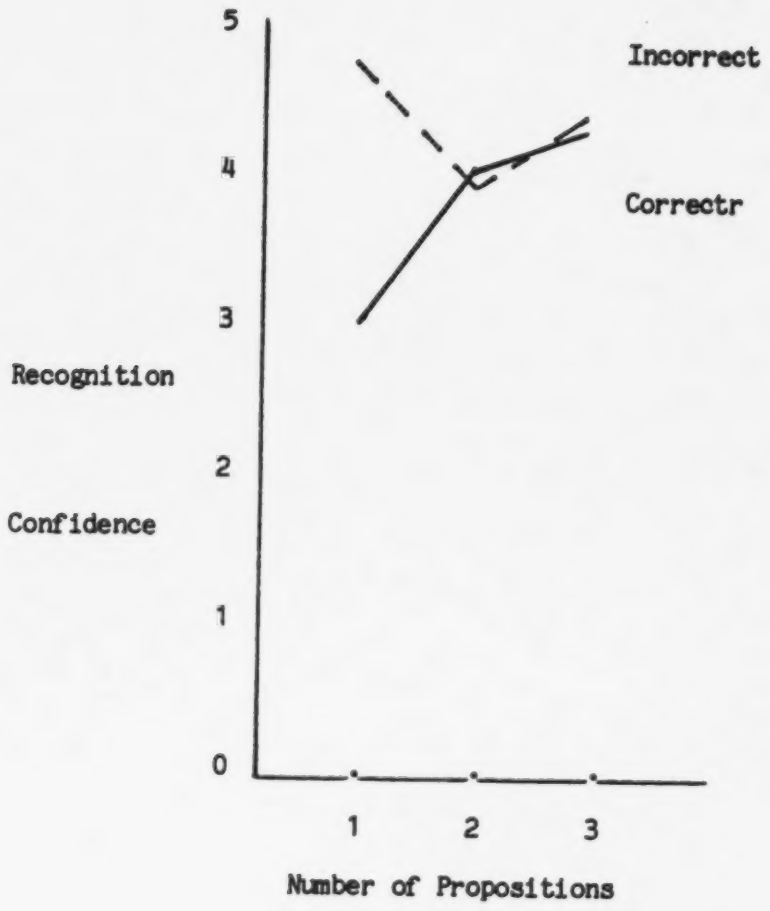

Figure 6. CP Interaction - Literal Items. Correctness by Proposition.

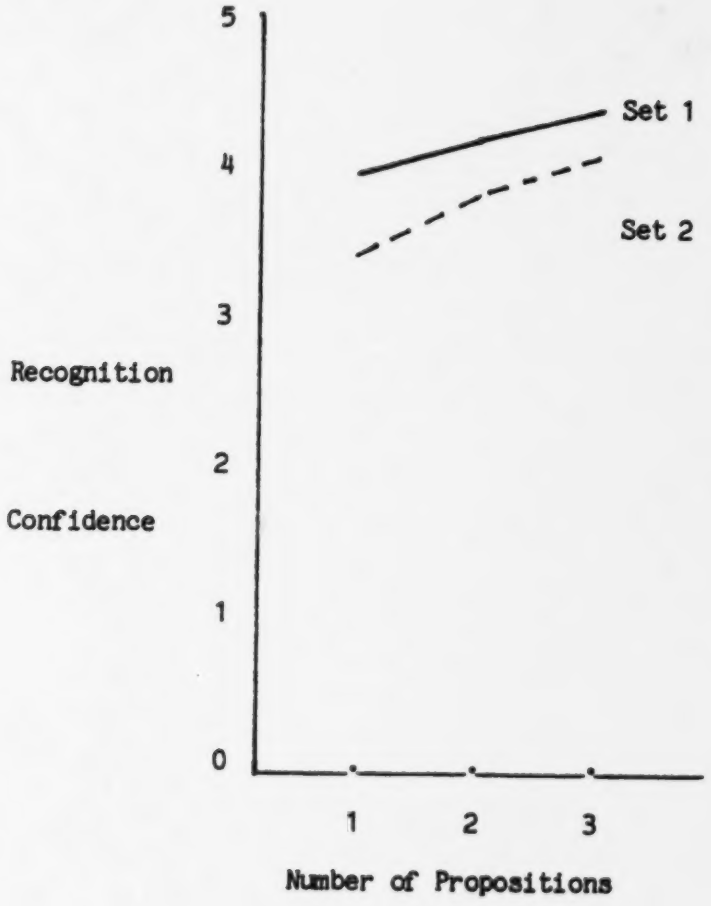

Figure 7. SP Interaction - Literal Items. Set by Proposition.

incorrectness of sentence content when only one proposition is present.

This effect seems to be more pronounced in the first set of items than in the second set, as shown in Figure 7. There were no significant three or four-way interactions for literal items.

Discussion

The most consistent finding across Experiment 1 and Experiment 2 supports previous research that verbatim memory ability has little, if any, relationship with general ability. For the treatment and control groups in Experiment 2 and all subjects in Experiment 1, individual differences on literal items showed negligible correlations with general ability.

The tendency for subjects to recognize the four-proposition overall ideas was significantly related to general ability for the treatment group in Experiment 2. Although this relationship was consistent with the results of Experiment 1, the relationship was not strong. However, it was expected that, in general, relationships between task performance and ACT scores would be higher for the control group rather than for the treatment group. The opposite results occurred. This unexpected shift may be due to several problems. First, both the test and the experimental task were administered individually in Experiment 1, whereas the experiment was conducted in group sessions in Experiment 2. Second, The Raven Advanced Progressive Matrices and the Vocabulary subtest of the WAIS-R provided a better estimate of general ability than ACT scores. Third, Experiment 1 used extreme groups, while Experiment 2 used a more homogeneous sample of subjects. Fourth, subjects in Experiment 1 appeared to have been more cooperative than subjects in Experiment 2, probably due to the individualized administration.

The tendency for high ability subjects to integrate more information than low ability subjects as propositions increased confirms the third prediction. Again, high ability subjects in the treatment group of Experiment 2 tended to show this relationship more consistently than did the high ability subjects in the control group of Experiment 2. In general, this indicates that for high ability subjects, performance depends increasingly on general ability when more propositions must be integrated.

GENERAL IMPLICATIONS

Bransford and Franks (1971) argue that subjects integrate information presented in a set of semantically related set of ideas and store the information as a structurally integrated memory set. Experiment 1 replicated the Bransford and Franks study but suggested that their findings hold only for older, more able students. In particular, Experiment 1 showed that older, more able students integrated semantically related sentences better than younger, less able students.

Although Experiment 2 failed to replicate these findings, other studies also failed to replicate Bransford and Franks findings. In a review of the literature, Alba and Hasher (1983) found that the effects for integration of idea units often disappear with procedural or instructional modifications in the Bransford and Franks method. Both the procedures and instructions were changed in Experiment 2 which may account for the replication failure.

In summary, the results of Experiment 2 were consistent with those of Experiment 1 in that significant, moderate correlations between semantic memory and general ability were found. However, this relationship was not as strong as found in Experiment 1. Results of Experiment 2 also supported both the results of Experiment 1 and previous research indicating that there is little relationship between literal recognition and general ability. However, the experimental manipulation in Experiment 2 failed to work as expected. Subjects in the control group performed better than subjects in the experimental group, and more importantly, performance was more highly related to general ability in the experimental group. One interpretation of this effect is that the experimental manipulation made the task more difficult, rather than easier, or at least encouraged subjects to attend to the task.

Finally, even though the findings lend some support to the hypotheses, it is suggested that further studies be conducted to investigate the relationship between general ability and semantic inferencing. It is suggested that individual general ability measures, such as those used in Experiment 1, be obtained rather than a measure such as the ACT to assess an adequate ability assessment. It is also suggested that the experimental testing be conducted on an individual basis to improve motivation and provide individualized attention. Future studies in this area should use more natural context for inferencing, such as text comprehension, rather than a somewhat artificial and unstable sentence integration paradigm such as Bransford and Franks employed.

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